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Halifax, NS

Chairperson: Don Bowen
Editor: Christine Abraham

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Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

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SUMMARY

The National Marine Mammal Peer Review Committee (NMMPRC) holds at least one annual face-to-face meeting to conduct scientific peer-review of marine mammal issues. This approach provides the opportunity to bring together experts on marine mammals from Fisheries and Oceans Canada (DFO) with specific contributions from non-DFO experts to ensure high quality review of the scientific results and to provide sound scientific advice as the basis for the management and conservation of marine mammals in Canada. When time permits, this annual meeting is also an opportunity to review ongoing research projects and provide feedback or guidance to the scientists involved. In addition to these Proceedings, several Research Documents and Science Advisory Reports will be published as a result of the meeting.

The meeting was held at the Cambridge Suites Hotel (Halifax, NS) from October 20 – 23, 2015. The participants invited to this meeting included individuals from DFO (Ecosystems and Oceans Science, Ecosystems and Fisheries Management, Species at Risk), Dalhousie University, Institute of Marine Resources (IMR), National Oceanic and Atmospheric Administration (NOAA), WWF Canada, Nunavut Wildlife Management Board, Nunavik Marine Region Wildlife Board, Makivik Corporation, and Nunavut Tunngavik Inc.

SOMMAIRE

Chaque année, le Comité national d'examen par les pairs sur les mammifères marins (CNEPMM) organise au moins une réunion en personne où l'on procède à un examen scientifique entre pairs de questions touchant les mammifères marins. Cette approche, qui réunit des experts en mammifères marins de Pêches et Océans Canada (MPO) et des experts externes au MPO, permet d'effectuer un examen de qualité élevée des résultats scientifiques et de formuler des avis scientifiques fiables qui serviront de fondement à la gestion et à la conservation des mammifères marins au Canada. Lorsque le temps le permet, les participants à cette réunion en profitent également pour se pencher sur les projets de recherche en cours et formuler des commentaires ou des conseils à l'intention des scientifiques qui y prennent part. En plus de ce compte rendu, plusieurs documents de recherche et avis scientifiques seront publiés à la suite de la réunion.

La réunion a eu lieu à l'hôtel Cambridge Suite (Halifax, N.-É.), du 20 au 23 octobre 2015. Les participants invités à cette réunion comprenaient des employés du MPO (Sciences des écosystèmes et des océans, Gestion des écosystèmes et des pêches, Espèces en péril), de Dalhousie University, de l'Institute of Natural Resources (IMR), de la National Oceanic and Atmospheric Administration (NOAA), du Fonds mondial pour la nature (WWF) du Canada, du Conseil de gestion des ressources fauniques du Nunavut, du Conseil de gestion des ressources fauniques de la région marine du Nunavik, de la société Makivik et de Nunavut Tunngavik Inc.

WORKING PAPER 1: HUMAN-INDUCED INJURIES AND MORTALITIES TO CETACEANS IN CANADIAN MARINE REGIONS

By D. Themelis, L. Harris, and T. Hayman

Rapporteur: L. Postma

Discussion: There was wide recognition from the committee regarding the importance of collecting and organizing this data for use as a baseline for moving forward. However the discussion focused on the significant limitations of the data presented and several recommendations were made to change the focus of the Research Document.

First, the scope should be changed, as suggested by the author, to include only the data and analyses for Atlantic Canada. The data from other regions was unavailable at present and/or too incomplete to meet the objectives of the analysis. However, the data from the Pacific Region is being reviewed and may be available in the future. It was also noted that there is more data available for the Arctic Region in databases that were not included in the present working paper. It was recommended that the authors should contact Robert G. Young, AARD Division Manager in Winnipeg (Central and Arctic Region) for his assistance in accessing this data. This is also true for the Newfoundland Region. There is additional observer/fishermen data for small cetacean bycatch that was not included and this may be obtained with the assistance of Jack Lawson.

There were concerns about the definitions and identification of degrees of harm for animals reported as injured. This may lead to inconsistencies in the data. There was a suggestion that a group of experienced/knowledgeable people (or at least two people) look at the data to make the final determination of the level of injury and interpret categories. This is a protocol used by the US.

Another issue of concern was the fact that the data gathered by stranding and entanglement networks (largely NGOs) can be interpreted as a minimum count only. Improving the effort would only be achieved by better monitoring programs. The scope of such programs would be very expensive and it is unlikely that such resources will be forthcoming.

It was recognized that level of effort is not the only limitation for the collecting data on animals that have died due from human-induced harm. The counts that are based on discovered carcasses are again minimum counts due to animals that sink and/or are otherwise lost not being captured. There was some speculation on whether there was any way to estimate the number of animals that are being missed. For example, would there be a way to qualify the "freshness" of discovered carcasses? This may help to estimate how soon carcasses are being discovered after death and this may then be able to estimate how quickly carcasses are being discovered which could perhaps give an idea of how much is being missed. There was agreement that ideas could be discussed to find a way to improve the discovery rate of carcasses. It also is harder as time goes on to determine the cause of death of a carcass. Just improving the way carcasses are reported on would improve the determination of how the animal died. The standardization of stranding network protocols also needs to be examined, as well as the response capabilities of stranding networks. If all strandings could be responded to, then the numbers could be more statistically meaningful.

The second type of data in the analysis that was discussed was fishermen and fisheries observer data which captures more of the information for small cetaceans harmed/killed as bycatch. There is likely more data available (e.g. the numbers for harbour porpoise seem too low in the working paper, especially for Newfoundland where the fishermen are reporting much higher numbers) both published and unpublished, that could be used for the analysis in the

Research Document. Discussion focused on whether or not there should be an increase in the number of observers (perhaps with the involvement of industry). It was acknowledged that the stranding networks are not an appropriate source of data/information for small cetaceans. There was a recommendation that the authors need to stress in the document that data from stranding networks may be a good source for identifying what species are being impacted, but in order to get actual numbers (with statistically valid measures of uncertainty) other sources of data (e.g. observer data) is needed. It was also noted that there are other options for gathering this type of data in the literature, for example, the use of questionnaires. It would also be good to see an analysis of the strengths and weaknesses of different methods of gathering the data we need to get statistically valid measures of mortality and injury of cetaceans.

Limited observer data was available, and as a result, there are information gaps. For example, the data for the Arctic is likely more complete than was has been reported in the earlier tables. The Marine Mammal Response Program (MMRP) is being reviewed in Ottawa right now and they are looking for ways to improve that program and data collection methods (suggestions are welcome). It is not clear what data goes into that program, where it comes from, etc. That is why it is very important to clearly separate and identify the data sources in the Research Document (recommendation) because much of the data used has been collected for different reasons. This creates limits on how the data can be used and interpreted.

There was discussion regarding the validity of the Potential Biological Removal (PBR) numbers used in the document. It was recommended to identify if the numbers were based on calculations for particular Canadian stocks or if the numbers used were from a PBR average for Canadian and American stocks combined. It was noted that for the purposes of providing the advice requested from this analysis, many of the PBRs reported in the table would not be appropriate. This will need to be re-examined and changed in the paper.

There was a question about the difference between total allowable serious harm and PBR. It was suggested that the difference lies in differences between how the US and Canada define these terms. They are comparable in concept, but the definitions are different. Perhaps more importantly, for many (almost all) of the Canadian stocks, there are not good recent estimates of abundance. Without these abundance estimates, it is not possible to calculate PBR with any confidence, thus providing advice relating to those numbers is not possible. It was also stressed that we need to know the limitations of the data and be able to determine a level of confidence in the numbers. We also need to have some measure of the level of effort associated with the data collected. It was noted that this is what is also missing for the analysis of estimates of abundance for many of the species and stocks.

Finally, there was discussion about the best way to proceed forward with this Research Document and Science Advisory Report (SAR). The following recommendations were made by the committee:

1. With the data that is available now and in the near future, the committee cannot address the request for advice related to this document as outlined in the Terms of Reference at this time;
2. The scope of the final Research Document should be limited to the Atlantic Region (not national as the status of the Pacific data is unknown and there is more Arctic data available);
3. The Research Document should be renamed "Preliminary analysis of Human-induced injury and mortality to cetaceans in Atlantic Canada";
4. There needs to be a clear explanation of what kinds of data are being used in the document and what you can do with it and what you can't do with it (i.e. the limitations of the data sources need to be clearly identified and stress the quality of the data. Also, that effort-

based data is needed to give a measure of uncertainty, indicating that the allowable harm numbers are incomplete, etc.);

5. There needs to be a legend on each table that outlines where the data comes from: stranding network? Observer data? Scaled observer data?;
6. The strong points of the analysis should be highlighted as well as the weak points – for example, a list of species can be developed (based on the existing analyses) that identifies which are the most vulnerable based on what we do know;
7. Once all of the limitations are identified, the committee can provide direction for the way forward and what would be needed to fulfill the questions outlined in the Terms of Reference at a later date, or at least what is needed to move on to the next stage. Indicate that a lot more can be done, but that it will not happen in the short term. It would be even better if these needs could be prioritized.
8. A SAR should still be developed with at least summary bullets outlining the main conclusions of the Committee's discussion. Don Bowen will provide assistance.

WORKING PAPER 2: ESTIMATE OF CUMBERLAND SOUND BELUGA (*DELPHINAPTERUS LEUCAS*) POPULATION SIZE FROM THE 2014 VISUAL AND PHOTOGRAPHIC AERIAL SURVEY

By M. Marcoux, B. G. Young, N. C. Asselin, C. A. Watt, B. Dunn, and S. H. Ferguson

Rapporteur: H. Moors-Murphy

Discussion: The following questions were posed as a starting point for the discussion:

- Are there suggestions/feedback about the method used to calculate the encounter rate variance?
- Are there suggestions/feedback about the method used to calculate variance between the replicate surveys?
- What are the group's thoughts about not using a correction for the estimated time that animals were in view?
- Has the issue with the low number of duplicates been adequately addressed?

Much of discussion focused on the difference in the estimate of the numbers of animals between the first (Aug 3rd and 4th) and second (Aug 10th and 11th) set of visual and photographic surveys, and whether only the first set of surveys should be used for the population estimate or if the two sets of surveys should be averaged to get the population estimate.

The following were points brought up regarding the visual surveys:

- The purpose of surveys should be considered. If the purpose is to provide a total population estimate or minimum number of animals, then perhaps it does not make sense to average the two surveys when they are so drastically different. If the purpose is to estimate the average number of animals that use the area throughout the time period, then the surveys should be averaged.
- If management requires a minimum estimated number of animals, then just using the first set of surveys would provide a more accurate estimate of the minimum number of animals.

- It is evident that the availability of the animals between the two surveys changed. The question is whether this changed due to movement of animals out of the area or due to a change in availability at the surface (e.g., a change in behavior of the animals).
- It needs to be considered whether the two sets of surveys are true replicates or not. If the behavior of the animals changed or the animals moved out of the area between surveys, then are we estimating the same thing between the two sets if surveys?
- The estimate of surface abundance for the second survey was lower than the number of individuals observed in the first survey. Additionally, the visual survey on August 10th showed some animals at the southern edge of the survey area, which suggests that some animals may have moved outside the range of the survey area. This provides some evidence that animals could have moved out of the area between the two sets of surveys, and thus it seems likely that the second set of surveys did not meet the assumption that all animals were included in the survey area.
- However, we do know that beluga survey counts can vary greatly over short time periods even when animals do not move out of an area (i.e., due to changes in behavior from one day to the next).
- The tidal cycles varied between the two sets of surveys – could this possibly explain the difference in the differences in the estimates?
- The issue with ignoring the last two survey days is that the number of animals could be overestimated relative to how past surveys were done. Traditionally, surveys have been averaged and dropping the low surveys (and thereby decreasing uncertainty around estimates) is misleading for comparisons to past estimates.
- It was suggested that future visual surveys should include more photographic effort.

The following are points brought up regarding the photographic surveys:

- Because there is complete coverage of the survey area, the numbers obtained from the photographic analysis suggest that the number of animals really did change between the two sets of surveys (i.e., the difference in the estimates was not due to a difference in area covered by the two surveys). Was this change caused by movement of animals out of the area, or is it more likely caused by a change in the availability bias?
- We know from past surveys of belugas in small areas that the number of animals observed at the surface can change drastically from one day to the next due to changes in behavior. It is possible that animals are not moving out of the area but behaving differently, such as diving more. The idea behind conducting multiple surveys and averaging is that they will capture this variability in availability bias and provide a more precautionary approach towards estimating population size and trends.
- It was asked if observers who conducted the visual surveys could possibly provide an indication as to whether they observed differences in behavior of the animals between the two sets of surveys. If so, this could provide some evidence that there was likely a change in availability bias between the two sets of surveys rather than a movement of animals out of the area.
- The amount of glare changed substantially between the two sets of surveys indicating that the availability bias likely differed.

The conclusion from this discussion was that the two sets of surveys, for both the visual and photographic methods, should be averaged as has been traditionally done. The Research

Document should state that the population could be underestimated because of this averaging and discuss the various issues brought up during this discussion including that the availability bias varied between the two different sets of surveys and how this impacts interpretation of the results.

The low value for the confidence interval for the photographic surveys (~7%) was questioned. Because this is a complete count the variance is expected to be low, but it was argued that the reported variance is much lower than expected and is likely an underestimate. It was suggested that it would be more appropriate to use standard deviation or a mixed model to provide a more accurate estimate of the variance.

It was suggested that the total count of animals obtained from the photographic surveys should be corrected for the number of duplicates. This could be done by removing the overlapping regions of the photos from the analysis (i.e., only counting the animals in the overlap region on one of the photographs). As a longer-term research project (beyond the scope of this Research Document), a more detailed analysis of the belugas counted in overlapping regions of the photographs could be used to investigate perception bias.

The question was posed as to whether a post-stratification should be applied to the surveys given the lack of sightings in the eastern side of the north stratum to reduce variability. It was advocated that post-stratification is not usually done in such analyses as this artificially increases certainty in counts, and rather it would be more appropriate to consider lack of sightings in this area when designing future surveys. There was general agreement that no post-stratification should be done.

The detection function curve and the method used to decide the right truncation point of 600 m was discussed. It was recommended that it would be valuable to fit a hazard curve to the data and select the point where the shoulder starts to estimate the truncation points. This will likely result in a similar distance to what was estimated from the curve visually, but would be a more appropriate method for choosing the truncation distance as it provides a less subjective method of choosing this distance.

It was recommended that blind replicates to test the consistency of the glare and murkiness categorization should be completed to increase confidence in this part of analysis and the correction factors applied for glare and murkiness. Further description of the methods used to estimate percentage glare and to categorize murkiness, and further justification for why we are confident in these subjective analyses, should be included in the Research Document.

WORKING PAPER 3: A COMPARISON BETWEEN VISUAL AND PHOTOGRAPHIC POPULATION ESTIMATES FROM AN AERIAL SURVEY OF NARWHALS

By M. Marcoux, N. C. Asselin, T. Doniol-Valcroze, and S. H. Ferguson

Rapporteur: J.-F. Gosselin

Discussion: There was a suggestion to evaluate overlap between successive photographs to match duplicate sightings and to use these to estimate changes in availability between photographs. However, it was concluded that this analysis doesn't have to be done and that it would not have an important influence on the final results.

As mentioned in the working document, the estimation of the proportion of the photographs affected by glare has to be finalized. It was suggested to clarify how glare was considered for the correction of counts, for identification of duplicates or for the estimation of the total area covered by photographs in the final estimation of density.

The main conclusion of the discussion was that the visual and photographic methods provided similar estimates of density. It was decided that completing the reading of all photos collected during the 2013 survey was not required. However, it was suggested that when possible, even if the photographs are not to be read systematically, photographs should be taken during visual surveys of this scale, as they provide a back-up to visual surveys for only a small increase in costs.

NOTE: The discussions of the following four walrus papers were fluid and topics relevant to all papers (e.g. use of appropriate recovery factors) may be repeated in the notes below.

WORKING PAPER 4A_I: TESTING ESTIMATORS OF WALRUS ABUNDANCE: INSIGHTS FROM SIMULATIONS OF HAUL-OUT BEHAVIOUR

By T. Doniol-Valcroze, A. Mosnier, M. O. Hammill, and J.-F. Gosselin

Rapporteur: Sheena Majewski

Discussion: There was some discussion regarding whether there are enough datasets to evaluate how rho might vary from one estimation to another. From the literature, we can consider rho to be between about 5-15%. Was rho consistent between haulouts? This seems to be consistent with what has been observed in haulout studies.

There was a suggestion to conduct model runs that demonstrate number of surveys needed to get convergence in the different models. Although the authors agreed that this was a good suggestion, they noted that in practice it would be difficult to get more than one estimate in any survey year. Thus, estimation of stock status will have to rely on methods that use single estimates.

The Committee suggested that the authors should justify in paper that p is a constant in the estimate of variance, and that Tables 1 and 2 should be better explained.

WORKING PAPER 4A_II: ESTIMATING ABUNDANCE AND TOTAL ALLOWABLE REMOVALS FOR WALRUS IN THE HUDSON BAY-DAVIS STRAIT AND SOUTH AND EAST HUDSON BAY STOCKS

By M. O. Hammill, A. Mosnier, J.-F. Gosselin, J. W. Higdon, D. B. Stewart, T. Doniol-Valcroze, S. H. Ferguson, and B. Dunn

Rapporteur: Sheena Majewski

Discussion: Binomial distribution was used to estimate variance in count data for this paper (the recommendations of WP4a_i were not incorporated). The authors recommend moving to a Simple Count approach for this and future assessments; the Bounded Count Approach and Minimum Counted Population Approach were examined for comparison to Simple Counts as ways to look at large variability in haulout proportions and count data in this paper. The authors intend to apply the approach from WP4a_i to determine and examine the impact of inflated variance on PBRs. This paper also considered whether additional historical data could be used to assist in providing management advice.

There was discussion regarding comparability of past survey data (in terms of high variability in estimates and the survey area covered) and whether the survey design changes affect the trajectory of population estimates over time and therefore our perception of recovery. It was recommended that the authors conduct a sensitivity analysis examining the impacts of including early survey data, to be included along with the existing model in the Research Document, along with the resulting range of harvest levels consistent with current understanding for

decision by managers. The implications of removing the historical data on whether the population would be evaluated as data-rich (allowing for use of a risk-based approach) versus data-poor (relying on PBR versus risk-based models) was considered. The committee recommended that there is a need for clarification of the management objectives for this population, as the implications of incorporating the highly variable historical data (and therefore the difference between evaluating under a data-rich versus data-poor scenario) could be significant in terms of the management advice given. The preference of the authors would be to use the Bayesian model in providing advice; the committee decided that further analysis and more surveys would be need to allow a shift to a risk-based approach for this population.

The question was raised regarding the appropriate Recovery Factor (value of 0.5 or 1) to recommend; the discussion was continued after presentation of the Foxe Basin data as the issue is relevant to both papers. The group recommended that development of criteria for choosing recovery factors is necessary before any recommendations can be made; in the interim, the authors will provide a range of options to managers to allow them to make a choice based on management objectives.

The committee decided that while we are moving towards model-driven PBR estimates, the use of the model-driven approach for determining PBR and recovery factor requires more discussion. For the current papers, all methods will be presented to allow comparison to past assessments but Simple Counts will be used in recommending PBR. More surveys were recommended to allow transition to a data-rich situation for assessing this stock and use of risk-based models.

There was some discussion regarding stakeholder perspective, which was requested to be included in the Proceedings (as follows). In Coral Harbour, hunters report that walrus are now seen in greater numbers much closer to the community and are seen more frequently throughout the year in the Southampton Island area. The walrus hunts for the last ten years have harvested walrus closer to Coral Harbour (within 40-50 kilometres). Hunters believe that the walrus harvest has declined because of a reduction in the demand for walrus meat due to fewer dog teams

Hunters from Cape Dorset report increased sightings of walruses near the community. The majority of the walruses are harvested during the late fall and winter from the floe edge by boat in open water areas. In the fall walrus are seen migrating east along the pack ice. It is believed that these animals originate from the south Foxe Basin and North Hudson Bay area. There are walrus at the floe edge throughout the winter.

In Sanikiluaq hunters report that, in the past, there were many walrus near the community and neighboring islands. Now there are very few walrus seen near Sanikiluaq. Walrus hunts are now conducted near the Sleeper Islands during September.

Hunters from Nunavik report that walrus hunting has declined because there are fewer dog teams to feed. There is concern about trichinosis particularly in the southern portions of the walrus range. There is concern among Inuit, particularly the four Eastern Hudson Bay communities, about the impact of hydroelectric development on marine wildlife.

WORKING PAPER 4B: MODELLING WALRUS POPULATION DYNAMICS: A DIRECTION FOR FUTURE ASSESSMENTS

By M. O. Hammill, T. Doniol-Valcroze, A. Mosnier, and J.-F. Gosselin

Rapporteur: Nell den Heyer

Discussion: Walrus surveys and population estimates were presented, and a large number of parameters for the population model and the estimation of the PBR were discussed. The use of PBR for harvest advice was discussed. The PBR approach was established to provide guidance for incidental catches of data poor species, and intended to be precautionary. For harvested populations that have no history of depletion, the use of a higher, less precautionary recovery factor (e.g. F_r=1.0) was suggested. The model presented showed there were only very modest changes in the population since 1950s. But, it was noted that there was a large amount of uncertainty in the survey estimates and the model, and that a 0.5 recovery factor could be more appropriate. It was suggested that if PBR is used, then the population is likely data deficient, so F_r is usually 0.5. The Committee decided that both the recovery factor of 0.5 and 1.0, presented in the HBDS working paper (WP 4a_ii), would be presented in the Science Advice.

Two other options to the PBR method were suggested: 1) risk analysis based on model projections with a defined set of objectives that would include both targets and time periods to achieve targets, and 2) using the IWC approach whereby the risk of a specific harvest is assessed over a time period.

It was also suggested that historical catch, prior to the 1950s (e.g. the start of the models) should be reviewed to support claims that there is no evidence that walrus were not depleted.

In subsequent discussions it was suggested that the use of the PBR and the recovery factor be quantitatively assessed by extending the analysis provided by Wade (1998), such that guidelines for the application and parameterization of PBR could be established.

There was careful review of table 4b (WP 4a_ii) and it was noted that rounding to 100s resulted in population estimates that were exactly the same, but different PBRs because the variance in those estimates and hence N_{min} differed.

There was careful review of a number of advice scenarios (R_{max} of 0.7, 0.8; F_r of 0.5, 0.1) for the Hudson Bay Davis Strait (HBDS) walrus.

A major source of uncertainty in assessing walrus populations is the haulout or availability bias correction. Walrus have highly variable surveys, resulting from correlated haul out behavior and a large number of haulout sites. In the present analysis, the count at a haulout sight is assumed to be known perfectly. The correlation between individuals will be addressed following the method in previous WP4a_i. Further, only a few surveys were actually designed to estimate the variance in the proportion of walrus hauled out. It was noted that Lydersen et al. (2008) was a good study (as it addressed overdispersion in counts), but that the proportion hauled out was from a mean of all the studies (sample size = number of studies; n=6).

A third source of variability between surveys was the extent of the coverage. It was noted that the more recent and extensive surveys should be kept. It was suggested that the impact of the reduced survey area for the 1950s surveys be assessed by:

1. Down weighting the 1950s surveys. If the old data undersampled the population, this will allow for bias or relax confidence intervals so that they have less impact on the model, then the harvest records become more important.
2. Scaling up the 1950s surveys to the whole survey area of the more recent surveys.

3. Status quo model run: all surveys included.

The final decision was to run the model both without the early survey estimates, and scaled-up early survey estimates.

It was decided that the estimates of the current population from the models provided better population estimates than the survey data alone, and therefore should be used to calculate PBR. The MSY approach was thought to be risky, as although there is enough data to develop population model estimation of K and theta, many of the model parameters were correlated and not well informed by the data.

It was noted that the catch history for the HBDS stock is probably driving the model decline, and that for the Foxe Basin stock there was no contrast in the data to inform the model.

The Committee agreed that R_{max} = 0.8 in the most recent modeling is as good as it is going to get – this value was accepted as the new default.

The authors reran the model as described above, and results were essentially the same (carrying capacity [K], struck and lost, and shaping parameters remain about the same). The authors also presented new correlation matrices with the new time series, again with very similar results (no change in significant relationships). The new value of K was slightly lower, new value of theta was slightly lower, the new value of struck and lost was slightly higher, the new population estimate =7165, and the new PBR = 118-236. Therefore, results show it makes very little difference if we use the old data or not, soothe authors will present both sets of model runs in the Research Document.

WORKING PAPER 5: ESTIMATING ABUNDANCE AND TOTAL ALLOWABLE REMOVALS FOR WALRUS IN THE FOXE BASIN STOCK

By M. O. Hammill, P. Blanchfield, J. W. Higdon, D. B. Stewart, and S. H. Ferguson

Rapporteur: Nell den Heyer

Discussion: It was decided that the model-based population estimate will be used to calculate PBR, even though the risk-based removals method was more precautionary. Discussions on the use of a recovery factor of 1 or 0.5 were not conclusive. Again, it was argued that the lack of evidence for depletion of the stock suggested that the higher recovery factor might be appropriate, but that because the stock is data-poor and there is a lot of uncertainty in the population estimate, that lower more precautionary recovery factor would be appropriate. Other examples were discussed, including previous applications of PBR to walrus populations and beluga in Nunavut.

It was noted that walrus model – owing to long time period and the lack of evidence of depletion good candidate for density-dependence.

While reviewing the SAR there were more comments: an additional model run was presented to demonstrate that the when early surveys dropped there was little impact on the 2014 abundance estimate. It was decided that the advice would be based on the model including the older survey data.

Note of clarification that one of the estimates with the lowest proportion hauled out was not used because the proportion hauled out was not comparable to the other studies.

WORKING PAPER 6: HISTORICAL ABUNDANCE OF EASTERN CANADA - WEST GREENLAND (EC-WG) BOWHEAD WHALES (*BALAENA MYSTICETUS*) ESTIMATED USING CATCH DATA IN A DETERMINISTIC DISCRETE-TIME LOGISTIC POPULATION MODEL

By J. W. Higdon and S. H. Ferguson

Rapporteur: J.-F. Gosselin

Discussion: There were a few questions related the quality and reliability of the data from the logbook record. It is likely that the quality of the logbook data varied during the commercial hunting period, but the data "are what they are" and cannot be validated more than they have been and should be considered with caution related to the associated assumptions. Historical harvest levels probably changed due different factors. The high increase in catch levels may correspond to the time when ships were improved to get into areas with ice; the rapid decrease may reflect the time when availability of whales was reduced. It is possible that the southern bowhead stock in the St. Lawrence and Labrador might have been depleted, although it is not known if these animals might have represented a different stock. The bowhead catch levels might also have been affected by the switch from whalers hunting mostly right whales to bowhead whales. One suggestion was to look at a possible estimation of whaling effort within the logbook data and the time interval between successive catches if this is available.

The population model is fitted to a limited amount of data and the parameters estimated from the model should be presented with estimated uncertainty. The recent abundance estimates calculated in the 2000s were not used as they were believed to be underestimates. The different initial population sizes used for model projections have a great influence on the projected minimum population size and on the timing when the population started to increase again after the end of commercial exploitation. The results are sensitive to this initial population size and to the maximum rate of increase. Different methods or models should be investigated to provide some uncertainty around the initial population size value. The model predictions are also sensitive to the maximum rate of increase used and uncertainty should also be provided and examined for this parameter.

The model was fitted to a limited amount of data, but it was designed with the expectation of collecting more data in the future to improve our understanding of trends in this stock and to improve our estimations of the population dynamics parameters.

The historical population size is not intended to represent the carrying capacity (K) for the area used by this stock, but it was intended to be used as a reference point for a quantitative assessment of the stock. Despite the intention, there was concern expressed that little confidence can be placed in estimates of historical population size, given the uncertainties in the catch data, the general lack of knowledge on the vital rates of this species and how they might have changes over time, and the lack of realistic uncertainty associated with model estimates of historical population size. It may be helpful to use a notation for the initial population size other than *K*, which is a standard notation for carrying capacity. As it was pointed out carrying capacity may have varied in time, but the initial population should be a predicted value with uncertainty that should remain constant for the predicted trajectories.

WORKING PAPER 7: SCIENCE ADVICE ON THEORETICAL HARVEST REDUCTION SCENARIOS AND SUSTAINABLE CATCHES OF NWA HARP SEALS?

By M. O. Hammill, G. B. Stenson, and A. Mosnier

Rapporteur: Lianne Postma

Discussion: Discussion focused on different model parameters and the influence of those parameters on the outcomes of the model.

It was clarified that the preferred mix of pups in the current harvest practice was 99% YOY. Therefore, to reach population targets, one would need to reduce the proportion of YOY in the harvest. The higher the proportion of YOY in the harvest, the longer it will take to reduce the population and to rebuild the population.

When evaluating harvest sustainability, the authors looked at what can be taken while still respecting management objectives for 15 years (to reflect the long lifespan of the species). The model then looks at the results and projects for another 15 years (so a total of 30 years projection). The uncertainty increases the further out you go in the projection.

A question was raised regarding why the confidence limits are so large around the estimates of pup production. This may be due to the estimates of survival, but more likely it is due to the variability in reproductive rates. However, this is a natural phenomenon.

For the projections, it appeared that the authors did not use density-dependence in pup production. It was clarified that in one simulation density-dependence was turned on, and in another simulation it was turned off. It was also noted that the environmental factor was applied to account for the variability between the average in the pup production rate and the observed variability. Additionally, the vector values for reproductive rate did not include 2014 and 2015 values. Also, the fitting factor took into account a value threshold.

Reproductive rates and first year mortality are driven by density-dependence, likely based on food availability. It is most likely intrinsic factors that most affect the population numbers, not extrinsic factors like harvesting (even though the harvest targets older animals). Reproductive rate data seems to be linked to capelin abundance data. Bad ice years also impact pup survival, but this is density-independent.

The authors were asked if they had considered using environmental data to model the reproductive rates and survival rates and using that information in the model. They had not, but have thought about it. It is difficult to do because predicting what ice conditions will be like is difficult due to choices of different climate models. There is an ice factor in the model that does not have a trend, it is just considered.

Looking at the conclusions of the document, one message is that if you want to maintain a higher harvest, then the 6.8 million animals target is a better target population.

Recommendations for the Research Document:

- In the tables, indicate that the numbers are catches per year
- In the discussion, highlight that the figures are arrived at using the using the model, but the consequences of projecting so far into the future are significant.
- In the discussion, point out that if adult survival changes for any reason, that change will have big impact on the numbers and the results of the modelled projections.

WORKING PAPER 8: ABUNDANCE OF ST LAWRENCE BELUGA FROM VISUAL LINE TRANSECT SURVEYS IN AUGUST 2014

By J.-F. Gosselin and M. O. Hammill

Rapporteur: Daphne Themelis

Discussion: It was noted that the bootstrapping for the most recent survey year was not completed before the meeting, but will be completed shortly thereafter.

Information regarding the survey altitude, the speed maintained during the survey and the type of aircraft will be included in the final research document. Viewing windows differ between planes and affect the amount of left truncation.

When trying to estimate a fairly flat line, bias in perception can be significant. Perhaps the degree of bias could be resolved by evaluating previous surveys. There are several years with multiple surveys, all with wide daily variation. These could be evaluated to determine the relationship between distribution of animals and environmental factors such as tide.

The animals move with the tide and there has been attempt to look at the movements within the summer range and correlate this with environmental factors. An analysis relating the density of animals to environmental factors was presented at the peer-review meeting in 2009. It was decided that this kind of analysis was difficult to do because conditions (e.g. water temperature) varied on a small scale and could not explain kernel density. Tide period might be a better correlate with density, but most other factors are not.

The survey results reported small cluster sizes with a small coefficient of variation (CV). It was asked if the observers close in on clusters during the survey? Perhaps a perception factor should have been applied, for example because of the type of plane (left truncation due to window shape).

The earlier surveys were used to develop expertise for Inuit participators. The plane was small with three seats and could only take two observers. There was variation in the expertise of the four observers; three were experienced, and the fourth became more adept over the survey. The number of days with useful data had to be reduced because of the inexperience of the fourth observer.

The difference between Figures 3 and 6 is that Figure 3 is the average yearly visual estimate while Figure 6 is the average of the daily estimate: there was a question as to why these appeared different.

The visual survey lines are weighted by effort and not by variance. They are corrected for effort because there have been changes in the extent of the survey over years. For example, the survey area was extended downstream from 2001-2009. The most recent survey extended to Rimouski. A weighting factor for effort is applied because there is one more line transect flown in some years. The overall extent of the survey is fairly consistent between years (770-800 km).

If the surveys don't cover the whole area in some years then there is no need to weight by effort. The variance in encounter rate will be biased by the differences in numbers between adjacent lines.

The average number for the 2014 survey will be provided after bootstrapping. A non-instantaneous correction factor should be added because perception bias raises the estimates. This will be done before the next survey to be incorporated in the model.

It was suggested that the pattern of beluga distribution in the Saguenay River should be examined. These animals may be more constrained during some part of the tide cycle. This could be a good time to survey to decrease the variance in encounter rate.

It was suggested that the August 20 sighting survey might produce the best estimate for that area from one day because it had the lowest CV and there were no missed sightings. But they would have to do that for every year, which would produce a different trendline. A similar problem was apparent in the sighting data for walrus.

It was suggested that the shape of the distribution in perpendicular distances be fitted with a modelling curve rather than truncating. This would improve the correlation. A similar method as used by Kingsley for surveys in the high Arctic.

Ship traffic might affect the distribution of animals on any given day. The traffic is recorded and available for comparison with the survey results.

Factors such as sea-surface temperature (SST) and tidal cycles could be investigated for their influence on encounter rates. These have been evaluated for spatial models, though not in the St. Lawrence estuary. The spatial scale is too small with tidal currents causing mixing between islands.

The final recommendation by the committee was to complete the bootstraping and calculate the confidence intervals.

ADDITIONAL TOPICS OF DISCUSSION: NOT PART OF THE PEER-REVIEW

PRESENTATION OF THE RISK-BASED FRAMEWORK FOR ASSESSING CUMULATIVE IMPACTS OF MARINE DEVELOPMENT PROJECTS (MDPS) ON MARINE MAMMALS AND TURTLES

Presenter: J. Lawson

- J. Lawson presented an update on the progress of the framework.
- How does the ERAF compared to CERAF? They are similar, and they are working with Miriam O in Pacific Region to be consistent with approaches.
- Total allowable harm has not been well-defined in Canada.
- Are there any case studies for data rich species for which similar frameworks have been applied? Yes, to some extent in Europe.
- If we can work this out for the super data-rich cases, we can evaluate where the major holes are for data-poor species.
- Will the proponents be responsible for collecting baseline abundance data? We may have to count on expert elicitation in many cases.
- Managers will have to provide the level of risk they are willing to accept.
- Many proponents will not provide recent (within 5 years) data because they don't want to reveal exploration location/strategy.
- This is a huge research project that will require perhaps a lot more resources than we currently have, both in terms of people and money.
- They will submit a two-year proposal to the Species at Risk branch to move this forward, but that doesn't really address the need for more people.

- Perhaps including more countries will improve the available resources (a formal structure would be helpful).
- In the future, we may ask the committee for expert elicitation especially for data-poor species.
- We also have to consider how we might be involved in mitigation monitoring.

IDENTIFYING CRITERIA FOR DATA RICH POPULATIONS

Presenters: S. H. Ferguson and G. B. Stenson

- For fish, the LCL (Lower Critical Limit) is in part defined as the limit below which there is recruitment failure. The LCL is more arbitrary for marine mammals. For marine mammals there is always bycatch that we cannot control, and we don't want bycatch to reduce population below LCL.
- In the USA, the Coefficient of Variation (CV) of the estimate influences the Recovery Factor (F_r). In the USA, the objective is for incidental mortality to be zero.
- You could apply a similar approach as Potential Biological Removal (PBR) to species at risk. There is no reason not to apply some kind of framework to those species. PBR is very similar to "allowable harm".
- There is some concern regarding having a generic approach for all species.
- The definitions of data-rich/poor were defined internally, whereas the Precautionary Approach (PA) is adopted by Canada and DFO.
- Should you consider a population or the species to be data-rich?
- Was the concept of data-rich/poor adopted in some ways to defend our use of PBR? No, rather it was just a realization that we had much more information on some populations/species than others. Where you are not comfortable with the info you have, then you have to use something, and so PBR, which is accepted internationally.
- Do we want to be even more precautionary with top predators?
- The basic framework for seals could be used for other top predators also – just use appropriate reference limits and this may vary between species. Folks agree that there is no reason this couldn't work.
- Getting annual (or periodic) estimates of mortality and fecundity data on cetaceans is going to be very difficult. Do we need this? If we have really good time-series of abundance estimates and the ability to forecast, this may be sufficient, but three surveys is not likely enough. So how many surveys are sufficient? How many surveys are needed to get a good estimate of R_{max} (maximum recruitment rate)?
- Managers need to define objectives and decision rules.
- LCL should be much more conservative for bowhead than ringed seals due to differences in R_{max} and other life history traits.
- In some cases management units will be for a species, others for a stock/population.
- Do we have to look at this opportunistically or can we come up with some general guidelines?
- PBR is really just a pre-packaged risk model.

- Life-history characteristics are important – desired frequency of surveys depends on life-history (and also on the precision of the survey).
- We could use the seal framework as a guideline, but management objectives are absolutely needed in any case.
- There are international straddling stock agreements and land claims; these agreements also call for conservation measures, so hunters and co-management groups need to get on board. Resource users are supposed to respect conservation measures. How would a conservation concern actually be defined? We shouldn't get this mixed up with Basic Needs Level (BNL).
- Land claims agreements supersede the *Species at Risk Act* (SARA).
- The PA was developed in part to help evaluate the health of the population.
- If Alaskan populations of marine mammals are above the Maximum Sustainable Yield (MSY), then they can be harvested. This is consistent with our approach and framework.
- Do we still agree with the concept of separating data-rich/poor (regardless of how defined)? This concept is very useful to highlight the need for surveys. For example, you can fit a model to three surveys. The first step is to get very good estimates of abundance, or even better, estimates from multiple surveys.
- The International Whaling Commission (IWC) tunes their models to account for hunting interest.
- If higher catches are desired, then the objective should be collecting the data to allow a data-rich approach
- What could be included in your data-rich model?
  E.g. uncertainly in carrying capacity, recruitment
- No easy way to determine what F_r should be – this will require simulations and can't be talked out.
- For SARA species, could simply start with F_r=0.1.
- Optimum Sustainable Population (OSP) uses a set of criteria for species at risk – this same concept could be applied to SARA species in Canada.
- For now, all we can do is evaluate F_r on an *ad hoc* basis until the simulations can be evaluated.
- Mike Hammill will work on compiling the F_r's used for various species/assessments to evaluate what has been used in the past.
- Perhaps this is a request that EFM or science should submit for the next fall meeting. This would be a very ambitious undertaking to address.

MARINE MAMMAL SURVEY PRIORITIZATION DISCUSSION

Presenters: C. L. Abraham and M. O. Hammill

Background

In 2007, the National Science Directors Committee (NSDC) initiated actions to develop a plan for marine mammal monitoring over a floating 10-year period. NSDC reviewed the first draft of the proposed 10-year schedule in February 2009, and recommended that a risk analysis be

included as a basis to establish priorities. In response, CEMAM adapted this plan, to a framework based on client needs using the CSAS risk-based methodology of establishing priorities.

The objectives of this plan are:

1. to address the needs of client sectors (e.g. EFM, SAR, Oceans),
2. to apply a risk-based mechanism to determine marine mammal survey priorities in a given year and across years,
3. to facilitate securing stable funding for our marine mammal survey programs, and
4. to place marine mammal surveys on equal footing with other sectors (e.g. groundfish, salmon) in meeting stock assessment requirements.

Long-term biological abundance and distribution datasets are critical for providing advice for ongoing programs (e.g. harvesting-beluga, narwhal, seals), meeting the needs of the *Species at risk Act* (e.g. critical habitat), research programs (e.g. evaluating impacts of climate change, invasive species) and meeting new demands (e.g. proposed MMPA rule change). The multi-year nature of this plan reflects the longer lifespan of many of these species, meaning that rapid changes are unlikely to occur naturally, as well as the reality that financially and from a capacity perspective, repeating all surveys annually is not possible.

The survey plan has now been in use for several years. Although the frequency of some surveys have not yet been decided upon (e.g. there are some surveys that have never or rarely been conducted historically), this is meant to be a dynamic tool and may be revised as new information becomes available. To date, we have received considerable input from Science and EFM nationally and regionally, and will continue to revise the plan as we receive new information.

Proposed Changes

In early 2015 , as part of an exercise to re-evaluate risk scores based on the CSAS method (see below), the regional marine mammal leads expressed concern regarding this method (which includes evaluation of non-science issues), and proposed instead to evaluate surveys based on science-related priorities only (also see below). It was decided to discuss at NMMPR how science-related priorities might be developed as part of the survey prioritization process. With this in mind, a list of alternate risk categories based on science priorities was developed as a strawman, and is provided for discussion (see below).

Current CSAS method –The current approach identifies 5 broad categories for evaluating the importance of completing surveys of a stock. The objective is to evaluate the likelihood and impact scores of each of the following risk categories (i.e. what is the risk to the Department of not conducting a survey and not providing science advice?):

1. Environmental / Biological
2. Legal / Regulatory
3. Public & Stakeholder Confidence
4. Alignment with DFO Priorities
5. International Commitments

Likelihood and Impact: Each activity (survey) is scored for likelihood and for impact associated with NOT conducting a survey. Even though likelihood and impact are related, they are scored independently.

Likelihood: If Science Advice is not provided (i.e., if the survey is not completed), what is the likelihood that the lack of scientific information or advice will result in management decisions that will significantly affect the species, habitat(s) or ecosystem(s) of concern?

Impact: If Science Advice is not provided (i.e., if the survey is not completed), what impact does the lack of scientific information or advice have on management decisions that will significantly affect the species, habitat(s) or ecosystem(s) of concern?

Likelihood scores are assigned using the following scale:

1. **Rare (<5%):** Almost never observed – may occur only in exceptional circumstances.
2. **Unlikely (5% - 24%):** Has occurred infrequently before to others in similar circumstances, but not here.
3. **Moderate (25% - 75%):** Has occurred here before, or has been observed in similar circumstances.
4. **Likely (76% - 95%):** Has occurred here more than once, or is occurring to others in similar circumstances.
5. **Almost Certain (>95%):** Occurs regularly here.

And Impact corresponds to:

1. **Negligible**: An event, the consequences of which can be absorbed through normal activity.
2. **Low**: An event, the consequences of which can be absorbed but management effort is required to minimize the impact.
3. **Medium**: A significant event that can be managed under normal circumstances by the organization.
4. **High**: A critical event that with proper management can be addressed by the organization.
5. **Extreme**: A major event that will require the organization to make a large scale, long term realignment of its operations, objectives or finances.

Proposed method (straw dog for discussion) - evaluate the likelihood and impact scores of each of the following risk categories:

1. Sustainable harvest – This is the objective managers have tended to focus on for harp and grey seals and many of the Arctic species. Clearly, in situations where these species are harvested or there is an expectation that they might be harvested, having current and periodically updated information on population status is essential. Eastern Canadian grey seals are a good illustration of this at the moment as without current information on pup production our confidence in stock size and trends is low and rapidly becoming more uncertain with each passing year.
2. Ecosystem-based management - Many marine mammals are large, wide-ranging, and abundant species whose consumption of prey is known or suspected of having significant impacts on the structure and functioning of ecosystems as a whole or highly valued species of those ecosystems, such as shellfish in the case of otters and finfish in the case of cetaceans and pinnipeds. Consumption by marine mammals is a source of time/space-varying mortality that must be accounted for if we are to provide the best stock assessment advice for highly valued species such as Atlantic cod, herring, hake, and others. That these sources of mortality are not routinely used in finfish stock assessments reflects only the slow pace with which we have progressed beyond single-species assessment and not the value of incorporating marine mammal predation morality in assessments.

3. Industrial development effects – Canadian oceans are increasingly under pressure from marine development and shipping raising concerns about the impact of development on marine mammal populations. Although the effects of noise on marine mammals may often be the more immediate threat, this threat cannot be adequately evaluated without current information on the size and distribution of the population. Ongoing surveys are an essential component of threat assessment of development on marine mammals.
4. Conservation – Current and ongoing estimates of abundance and distribution from surveys are an essential component of recovery plans for marine mammal species listed under SARA. Recovery targets almost universally contain objectives with respect to abundance and the evaluation of management actions requires timely information of changing in abundance and distribution.

Ultimately, even if Science sets its own priorities for stock assessment, we must take into account the priorities of other sectors (e.g. Fisheries Management, Species at Risk, etc.). We will continue to ask the relevant client sectors for their input regarding priorities (and justification) each year.

There was some discussion regarding the proposed revised method, and participants generally expressed support for the Science sector evaluating survey priorities based on biological and environmental risk parameters than some of the risk parameters in the original CSAS method (e.g. Legal/Regulatory risk, Public & Stakeholder Confidence risk, Alignment with DFO Priorities, International Commitments).

There were additional ideas discussed for possible future inclusion into the survey prioritization scheme, for example:

- value of multispecies surveys
- value of supplementary studies (e.g. genetics) that contribute to abundance surveys

DFO marine mammal science staff will continue to discuss and evaluate a new method for prioritizing surveys that will focus more on biological and environmental risk parameters. At the same time, we can still take into consideration our client sector survey priorities each year.

APPENDIX A – TERMS OF REFERENCE

ANNUAL MEETING OF THE NATIONAL MARINE MAMMAL PEER REVIEW COMMITTEE (NMMPRC)

National Peer Review - National Capital Region

October 20-23, 2015
Halifax, Nova Scotia

Co-Chairs: Don Bowen and Garry Stenson

Context

The National Marine Mammal Peer Review Committee (NMMPRC) holds an annual meeting to conduct scientific peer-review of marine mammal issues. This meeting provides the opportunity for collaborative review of scientific results by marine mammal experts from Fisheries and Oceans Canada (DFO) and from other (non-DFO) organizations. Following NMMPRC peer-review and approval, scientific results are used to provide sound scientific advice for the management and conservation of marine mammals in Canada. When time permits, this annual meeting is also an opportunity to review ongoing research projects and provide feedback or guidance to the scientists involved.

Objectives

This year, the papers to be reviewed will include topics pertaining to high Arctic narwhal, beluga and bowhead whale, Hudson Bay/Davis Strait Atlantic walrus, St. Lawrence beluga, harp seal, and human-induced mortality on Atlantic marine mammals (see below for individual topics).

Topics

1. Rate of human-induced injury and mortality to marine mammals in Atlantic Canada

Context: In a landmark settlement reached in early 2015, the U.S. government agreed to adopt new rules that ensure seafood imported into the United States meets high standards for protecting cetaceans. The long-delayed regulations will require foreign fisheries to meet the same marine mammal protection standards required of U.S. fishermen or be denied import privileges, thus implementing a 40-year-old provision of the Marine Mammal Protection Act. Since 1972, the U.S. Marine Mammal Protection Act has prohibited the United States from allowing seafood to enter the country unless it meets U.S. whale and dolphin standards. Under the new settlement, the federal government must make a final decision by August 2016 about how to implement this requirement and end unlawful imports.

Section 101(a)(2) of the MMPA states: "the Secretary of the Treasury shall ban the importation of commercial fish or products from fish which have been caught with commercial fishing technology which results in the incidental kill or incidental serious injury of ocean mammals in excess of United States standards". In order to show that Canada is meeting U.S. requirements, we must evaluate how much serious harm and mortality to cetaceans is due to fisheries interactions.

Objectives: To evaluate

1. the average rate of human-caused serious injury and mortality to cetaceans for the most recent seven years of data,

2. how these estimates of mortality compare to the U.S.-calculated Potential Biological Removal (PBR) or allowable harm, and
3. how can this information be used to monitor success of actions identified in *Species at Risk Act* (SARA) recovery plans for SARA-listed cetaceans in Canada.

Expected Publications:

- One Science Advisory Report
- One Research Document

2. Cumberland Sound Beluga (CSB) - population abundance estimate and sustainable harvest level recommendations

Context: In 2004, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) recommended that CSB be designated as "Threatened" under the *Species at Risk Act* (SARA). Continued research and monitoring of this beluga population is required to ensure sustainability of the Inuit subsistence harvest. Fisheries Management and its Nunavut co-management partners are developing an Integrated Fisheries Management Plan (IFMP) with the community of Pangnirtung. An aerial survey of Cumberland Sound beluga was conducted in summer 2014. Based upon this survey, DFO will provide Science Advice that can be considered by the Nunavut Wildlife Management Board (NWMB) to evaluate the sustainability of the current quota, and the level of Total Allowable Harvest (TAH) and Basic Needs Level (BNL) to be established for this beluga population.

There are two components to this request based on the recommendations contained in DFO (2013a). The first is to estimate abundance of CSB in 2014 based on the aerial survey data. The second is to complete Bayesian population dynamic modelling of the 2009 and 2014 aerial survey results, and if supported by this analysis, provide advice on an updated population abundance estimate and sustainable harvest levels (i.e., total allowable landed catch; TALC) for this population.

Objectives: To address the first component of the request and provide a population abundance estimate based on the aerial survey of CSB in 2014.

The second component of the request would be addressed in 2016.

Expected Publication:

- One Research Document

3. Evaluation of a portion of the 2013 narwhal photographic survey and potential application for future surveys

Context: Narwhals inhabit Arctic waters year-round and are facing tremendous changes in their environment, ranging from increased human activities (e.g., oil and gas exploration, shipping) to climate change. Narwhal also have widespread economic, social and cultural importance for Inuit, and it is therefore crucial to establish sustainable hunting levels based on accurate and up-to-date abundance estimates for long term sustainability of the stocks/populations. Obtaining these estimates, however, is complicated by the population structure of narwhals, which is separated into several summering aggregations with varying degrees of site fidelity, and by poorly understood migration patterns that bring narwhals seasonally to a number of Nunavut and Greenlandic community hunting regions.

DFO conducted a comprehensive aerial survey of narwhal in key areas of the eastern Canadian Arctic using both visual and photographic methods in August, 2013. Together, the survey covered the Canadian range of summering aggregation areas of the Baffin Bay narwhal

population, as well as narwhals in Jones Sound and Smith Sound. Several of these areas had never been surveyed before, some have not been surveyed for decades, and a comprehensive survey of the entire summer distribution of narwhals had never previously been attempted.

In Canada, narwhals are managed on the basis of known summering aggregations or stocks. Four stocks comprise the Baffin Bay narwhal population (i.e., Somerset Island, Admiralty Inlet, Eclipse Sound, East Baffin Island); and two provisional High Arctic narwhal stocks occur in Jones Sound and Smith Sound. Based on the visual component of the 2013 survey, DFO science has calculated updated abundance and TALC) estimates for these six narwhal stocks. A subset of the digital photographs taken on the 2013 survey transects were used to complement visual data for some stocks. However, the size of the entire photographic record, and the resources needed to analyse it, precluded computation of a full photographic abundance estimate at this time.

Objectives: The 2013 High Arctic Cetacean Survey (HACS) resulted in ~244,000 digital photographs taken from three aircraft. Over half of these photographs have been read, including all the areas where visual observers detected marine mammals. However, these results only provide complete coverage of the Somerset Island stock and the fiord component of the East Baffin Island stock. Reading the remaining images from the 2013 HACS will require considerable resources. Therefore, a stepwise approach is proposed for the evaluation of the entire photographic component of the survey:

1. Technical comparison of visual and photographic methods

   This will involve an initial comparison between the photographic and visual survey abundance estimates obtained only for the Somerset Island stock and the fiord component of the East Baffin Island stock. The results of this technical comparison will provide new information on an alternative approach to estimating narwhal abundance, and inform the required evaluation of its advantages and disadvantages, and associated statistical assumptions.

   DFO Resource Management originally requested interpretation of all of the digital imagery from the 2013 survey, and proposes that the NMMPRC review the complete reading and review the entire digital record in October 2016 (with priority given to the Eclipse Sound and Admiralty Inlet stocks). This approach would result in information or advice available for the scheduled revision of the narwhal IFMP (which expires in March 2017).

   At this time, it is uncertain how similar the results of this comparison will be and what factors may cause differences between the two survey methods. However, the results will assist decisions about using the digital imagery acquired from the other 2013 survey areas (e.g., whether it is necessary to read all of the remaining digital imagery for the other narwhal stocks surveyed in 2013), how the visual and photographic survey abundance estimates compare, how they can be combined in future, and whether revised scientific advice concerning narwhal abundance and sustainable harvest are appropriate.

Expected Publication:

- One Research Document

4. Walrus population abundance estimates and sustainable harvest recommendations for the Hudson Bay/Davis Strait (HBDS) and South and East Hudson Bay (SEHB) stocks

Context: Walrus is a key fishery for DFO and is reported on via the national Sustainability Checklists. DFO is continuing to build on the Sustainable Fisheries Framework for key fisheries that contains existing DFO policies for resource management decisions, and builds on new policies to address ecosystems factors and precautionary considerations.

There are six (6) walrus stocks or stock units in the eastern Canadian Arctic. Increasing national and international attention regarding how Canada is managing these walrus stocks requires the Department to be able to demonstrate that the harvests are sustainable, or take appropriate actions if current harvest levels are deemed unsustainable.

Currently, Resource Management in the Central and Arctic Region is leading the development of an IFMP for Atlantic walrus, and where there is sufficient information to do so, sustainable harvest levels will be included. Surveys, along with abundance estimates and PBR estimates, have been completed for the Baffin Bay-High Arctic (BB-HA) and Foxe Basin (FB) walrus stocks. However, abundance estimates and sustainable harvest level advice are still required for theSEHB and HBDS stocks. This advice will be used by the NWMB and the Nunavik Marine Region Wildlife Board (NMRWB) in the establishment of total allowable harvest (TAH), Total Allowable Takes (TAT) and BNLs. The management of the HBDS and SEHB stocks is shared between Central and Arctic, and Quebec regions, as well as between two land claims areas (Nunavut and Nunavik). Greenland also harvests from the HBDS stock.

The Atlantic walrus is currently listed on Appendix III of the Convention on International Trade in Endangered Species (CITES). As such, anyone wishing to export walrus parts or derivatives from Canada must obtain an export permit from the Canadian CITES administration. However, a non-detriment finding is not required for species listed on Appendix III of CITES. In 2009 and again in 2012, the United States consulted with range states on the possibility of putting forward a proposal to uplist walrus to Appendix II, citing potentially unsustainable exploitation rates, lack of scientific information on population abundance, high value international trade in walrus ivory, and the difficulty in distinguishing fresh ivory from fossilized as some reasons for seeking increased protection. If listed on Appendix II, a non-detrimental finding would be required for any continued trade in this species. It is likely that the USA will again consider submitting a proposal to uplist walrus to Appendix II in 2016. Having a formal management plan in place that identifies sustainable harvest levels will greatly assist in Canada being able to demonstrate sustainable management of walrus.

Objectives: To evaluate population abundance estimates and provide advice on sustainable harvest levels for the Hudson Bay-Davis Strait (HBDS) and South and East Hudson Bay (SEHB) Atlantic walrus stocks based on a survey conducted in summer 2014.

Expected Publications:

- One Science Advisory Report
- One Research Document

5. Evaluation of the relevance of historical Foxe Basin Walrus survey data towards determining sustainable harvest levels

Context: There are six (6) Atlantic walrus stocks or management units in the eastern Canadian Arctic. Increasing national and international attention regarding how Canada is managing these walrus stocks requires the Department to be able to demonstrate a sustainable harvest or take appropriate actions if current harvesting is deemed unsustainable. Science advice was published in 2013 (DFO 2013b) that provided Total Allowable Removal (TAR) estimates for four stocks, including Foxe Basin (FB). Based on the science advice, the current level of harvesting in FB exceeds the TAR, resulting in a conservation concern for this stock.

The current TAR advice (DFO 2013b) for FB was based on PBR estimates using a recovery factor (FR) of 0.5 as there was no information available, at that time, regarding trends in stock abundance. For several stocks, PBR was calculated using FR= 1.0, as there was no statistical evidence of decline in walrus numbers.DFO (2013b) provided a range in estimates

of PBR and TARs for each stock. In March 2015, survey data were identified that may provide information on trend in abundance of FB walrus, and may influence the recovery factor used in calculating PBR for this stock.

Objectives: To evaluate whether historic survey data can be compared or used to provide information on a trend in stock abundance for FB walrus. If the historical data are relevant for evaluating the FB stock trend, determine whether FR = 0.5 is most appropriate or if it is appropriate to calculate PBR using a different FR resulting in an updated range of TARs for this stock.

Expected Publications:

- One Science Advisory Report
- One Research Document

6. Eastern Canada / West Greenland (ECWG) Bowhead Whale - Historic Population Estimates

Context: ECWG Bowhead is a key fishery for DFO C&A Region. DFO has moved toward a Sustainable Fisheries Framework for key fisheries that contain existing DFO policies for resource management decisions, and builds new policies to address ecosystems factors and precautionary considerations, in support of the departmental direction toward Ecosystem Based (Fisheries) Management. Updated science, a science plan and a documented management approach is required for fisheries to be considered to be sustainably managed in this model. The Nunavut Land Claims Agreement (NLCA) requires a valid conservation basis on which to limit Inuit harvest, which requires science advice that we can be confident in.

Regional FM and Science have jointly developed a multi-year management plan that includes determining historic estimates of population abundance to inform the decision-making framework for this fishery that incorporates the Precautionary Approach.

DFO Science advice will be incorporated into draft IFMPs submitted for NWMB decision. Hunters will be affected if their current harvest exceeds sustainable levels. If current harvests are less than the recommended TAH, the allocation of any remaining surplus (above the BNL) is the responsibility of the NWMB.

Objectives: To evaluate whether historical bowhead population abundance can reliably be determined using available catch statistics, and if so to estimate the historical abundance. This is part of a longer term series of questions related to the need for a risk based population model to assess sustainable harvest levels for ECWG bowhead whales.

Expected Publication:

- One Research Document

7. Harp Seal Harvest Strategies

Context: In 2014, Canada submitted a request to NAFO for the Working Group on Harp and Hooded Seals (WGHARP) to explore hypothetical management options to reduce the Northwest Atlantic harp seal population. The WG, which met in November 2014, felt that this exercise should be conducted within the context of a Management Strategy Evaluation (MSE).
An MSE provides an approach for addressing both policy and process conflicts in harvest co-management. It is explicitly designed to examine ongoing or potential harvest strategies that are robust to uncertainty and natural variation, and that balance biological and socio-economic objectives. The management strategy evaluation process involves defining a set of operational objectives, identification of candidate management procedures (i.e. data collection, stock

assessment, and harvest control rules), and evaluates the performance procedures of the procedures against the objectives. In contrast to the earlier traditional approach to management, it does not necessarily identify an optimal strategy or decision. Instead it seeks to explicitly identify some of the trade-offs that may be necessary to achieve different management objectives.

The key components of this approach include: a clearly defined set of management objectives; fisheries data and stock assessment models; harvest control rule(s), a simulation framework that allows testing of the different management objectives taking into account different levels of uncertainty; and a means of calculating and presenting how the management objectives performed during the simulations, expressed in terms of conservation, socio-economic or other criteria (performance indicators).

The WG discussed how the scenarios (below) might be examined within an MSE environment. Since there are two models currently being used in the assessments of harp seals, one in the NE Atlantic and another for the NW Atlantic population, it was suggested that initially, the behaviour of the NE Atlantic model would be examined using the NW Atlantic assessment data to see how the model behaved when annual reproductive rate data were available. At the same time, the NW Atlantic model would examine the impacts of the different catch options on the population. Additional considerations included: updating the projections every 5 years, by assuming a new survey was flown to estimate pup production; assuming two different future trends in reproductive rates. One set of projections would assume that reproductive rates varied in a density-dependent manner, while a second series would assume that future reproductive rates would vary in a manner that has been observed over the last 5 years. The model comparisons and projections have been carried out over the past year, and reviewed by the WG via correspondence.

Objectives: Specifically, WGHARP was asked to evaluate the following:

1. Identify the catches necessary to reduce the population to 5.4M animals (the most recent estimate of N70, or 70% of the maximum observed population size) assuming:
    1. Catches consisting of 90% YOY and 50% YOY
    2. Over time periods of 5, 10,and 15 years
2. Identify the catches necessary to reduce the population to 6.8M (an intermediate level between the current estimate and N70) assuming:
    1. Catches consisting of 90% YOY and 50% YOY
    2. Over time periods of 5, 10,and 15 years
3. What would be the sustainable future catches possible with a reduced population and assuming there is a 95% probability of remaining above the Limit Reference Point (defined as the current N30).

Expected Publications:

- One Science Advisory Report
- One Research Document

8. St. Lawrence Estuary beluga abundance based on 2014 visual survey

Context: Until recently, the St. Lawrence Estuary (SLE) beluga population was listed as Threatened under the *Species at Risk Act*. However, a comprehensive review of the status of the SLE beluga population in 2013 (DFO 2013/076) concluded that the population had moved

from a period of relative stability to one of declining abundance in the early 2000s. This new information led to a new designation of the population as "Endangered" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2014.

Since the last SLE beluga aerial survey was conducted in 2009 there has been considerable growth in ecomonic/development activity in the SLE (e.g.TransCanada Corp.'s proposed marine oil terminal in Cacouna) and in summer 2014, a new SLE beluga survey was undertaken. It is important to note that the 2014 survey could not incorporate a photographic component (i.e. completed the visual survey only), and therefore, the 2014 survey represents a departure from previous survey methods which incorporated both components, and will therefore have to be taken into account when comparing results of the 2014 survey to previous estimates.

Objectives: To evaluate the results of the 2014 SLE beluga visual survey to provide a current abundance estimate.

Expected Publications:

- One Science Advisory Report
- One Research Document

Additional Expected Publication

In addition to the expected publications listed under each topic, meeting Proceedings will also be produced.

Participation

The following groups were invited to participate in the meeting:

- Fisheries and Oceans Canada (DFO) (Ecosystems and Oceans Science, Ecosystems and Fisheries Management, Species at Risk)
- Institute of Marine Resources (IMR), Norway
- National Oceanic and Atmospheric Administration (NOAA)
- Nunavut Wildlife Management Board
- Nunavik Marine Region Wildlife Board
- Makivik Corporation
- Nunavut Tunngavik Inc.

References

DFO. 2013a. Advice on size and trend of the Cumberland Sound beluga whale population, 1990 to 2009. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/003.

DFO. 2013b. Estimates of Abundance and Total Allowable Removals for Atlantic Walrus (*Odobenus rosmarus rosmarus*) in the Canadian Arctic. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/034.

APPENDIX B – LIST OF PARTICIPANTS

DFO

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External Reviewers and Stakeholders

Debi Palka - NOAA
Rod Hobbs – NOAA
David Lee – Nunavik Tunngavik Inc.
Danica Crystal – Nunavut Wildlife Management Board
Kaitlin Breton-Honeyman - Nunavik Marine Region Wildlife Board
Greg Gilbert – Makivik Inc.
Tonya Wimmer – WWF
Damian Lidgard – Dalhousie University

APPENDIX C – AGENDA

Meeting of the National Marine Mammal Peer Review Committee

October 20-23, 2015
Cambridge Suites Hotel, Halifax, NS

Co-Chairpersons: Don Bowen and Garry Stenson

Daily schedule plan as follows, but allow for some flexibility:
Start: 8:30 am
Break: 10:15 to 10:30 am
Lunch: 12:00 to 13:30 pm
Break: 3:00 to 3:15 pm
End: 5:00 pm

Day 1 – Tuesday October 20

Time allowed (min)	Paper #	Subject
15	n/a	Welcome and instructions for participants, rapporteurs, etc. (D. Bowen and G.B. Stenson)
60	Wp_1	Human-induced injuries and mortalities to cetaceans in Canadian marine regions (by D. Themelis, L. Harris, and T. Hayman)
60	Wp_7	Science Advice on Theoretical Harvest Reduction Scenarios and Sustainable Catches of NWA harp seals? (by M.O. Hammill, G.B. Stenson., and A. Mosnier)
15	**Break**	
60	Wp_8	Abundance of St Lawrence beluga from visual line transect surveys in August 2014 (by J. F. Gosselin and M. O. Hammill)
75	**Lunch**	
60	Wp_6	Historical abundance of Eastern Canada – West Greenland (EC-WG) bowhead whales (*Balaena mysticetus*) estimated using catch data in a deterministic discrete-time logistic population model (by J. W. Higdon, and S. H. Ferguson)
15	**Break**	
60	WP_3	A comparison between visual and photographic population estimates form an aerial survey of narwhals (by M. Marcoux, N. C. Asselin, T. Doniol-Valcroze, and S. H. Ferguson)
90	n/a	Presentation of the Risk-Based Framework for assessing Cumulative Impacts of Marine Development Projects (MDPs) on Marine Mammals and Turtles (by J. Lawson)

Day 2- Wednesday October 21

Time allowed (min)	Paper #	Subject
60	WP_2	Estimate of Cumberland Sound beluga (*Delphinapterus leucas*) population size from the 2014 visual and photographic aerial survey (by M. Marcoux, B. G. Young, N. C. Asselin, C. A. Watt, B. Dunn, and S. H. Ferguson)
60	WP_4a_i	Testing estimators of walrus abundance: insights from simulations of haul-out behaviour (by T. Doniol-Valcroze, A. Mosnier, M. O. Hammill, and J.-F. Gosselin)
	WP_4a_ii	Estimating abundance and total allowable removals for walrus in the Hudson Bay-Davis Strait and south and east Hudson Bay stocks (by M. O. Hammill, A. Mosnier, J.-F. Gosselin, J. W. Higdon, D. B. Stewart, T. Doniol-Valcroze, S. H. Ferguson, and B. Dunn)
15	**Break**	
60	WP_5	Estimating abundance and total allowable removals for walrus in the Foxe Basin stock (by M. O. Hammill, P. Blanchfield, J. W. Higdon, D. B. Stewart, and S. H. Ferguson)
30	WP4b	Modelling walrus population dynamics: A direction for future assessments (by M. O. Hammill, T. Doniol-Valcroze, A. Mosnier, and J.-F. Gosselin)
75	**Lunch**	
120	SAR_1	Serious injury and mortality estimates for cetaceans in Atlantic Canada
15	**Break**	
120	n/a	Identifying criteria for data rich populations

Day 3- Thursday October 22

Time allowed (min)	Paper #	Subject
90	SAR_8	SLE beluga SAR
15	**Break**	
90	SAR_7	Harp seal harvest SAR
75	**Lunch**	
90	SAR_4	Walrus SAR (HS-DS)
15	**Break**	
90	SAR_5	Walrus SAR (Foxe Basin)

Day 4 – Friday October 23

Time allowed (min)	Paper #	Subject
120	n/a	Marine mammal survey prioritization discussion
75	**Lunch**	
150	n/a	Any remaining discussion items